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TermiNet^{*}

DATA
COMMUNICATION
PRODUCTS

**TermiNet 9600
Remote Processing System
2780 Emulation User Manual
GEK-49299**



Electronic Services - Los Angeles

M14580X

MP MASTER



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The information contained herein does not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to General Electric Company, USA.



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SYSTEM DESCRIPTION

GENERAL INFORMATION

The TermiNet 9600 Remote Processing System utilizes TermiNet data equipment configured and controlled such that it is compatible with the IBM 2780 version of Binary Synchronous Communications (Bisync) line protocol.

The basic Bisync feature is as follows:

Multiple records may be transmitted in each data block. These records may be print lines or card images. A complete block of data is transmitted prior to an acknowledgement.

Data transmission is synchronous half-duplex at baud rates as high as 4800 baud. Communications may be carried out in EBCDIC code either transparent or non-transparent. Communications may also be carried out in ASCII code, non-transparent, 7-bit plus parity.

NOTE

The code set used is determined by the computer system requirements, and the TermiNet 9600 2780 emulation system is configured accordingly. There is no provision by which the equipment operator can change code sets on the equipment.

Error checking is carried out by performing a Cyclic Redundancy Check (CRC) method or a Vertical Redundancy Check (VRC) and a Longitudinal Redundancy Check (LRC). CRC is performed on data transmitted in the EBCDIC code, while VRC and LRC is performed on data transmitted in the ASCII Code. Error checking is automatic. No operator intervention is required.

LINE DISCIPLINE

GENERAL BISYNC PROCEDURE

The Bisync protocol, or procedure to control information, calls for a certain structuring of the data.

Typically, the following information is exchanged between the transmission and reception devices.

1. Message is available for transmission.
2. Start of text transmission.
3. Acknowledgement or rejection of the text due to errors.
4. Retransmission if message is rejected.
5. Transmit next data block if message is accepted.
6. Repeat 3, 4, 5, and 6 until message is completed.
7. End of transmission.

A typical Bisync message exchange is initiated when a location sends a synchronization (SYN) character and an enquiry (ENQ) character to another location. If the other location can accept the message, it acknowledges (ACK character is sent) the ENQ.

NOTE

Each transmission is preceded by at least 3 SYN characters, and concluded with at least one PAD character. Throughout the communications exchange, each ACK is alternately numbered 1 and 0. If an ACK is not received by the sender, the next one will be out of sequence and an error will be detected.

After an enquiry is acknowledged at the start of a communications exchange, the message text is sent. The communications exchange is terminated by the transmission of the End of Text (EOT) character. Bisync line discipline makes use of certain control characters. The following table (Table 1) lists the usable Bisync control characters and their definitions.

TABLE 1
BISYNC CONTROL CHARACTERS

CHARACTER MNEMONIC	CHARACTER MEANING	CONTROL FUNCTION
SOH STX	Start of Heading Start of Text	All data following an SOH or STX character is treated as text and entered into storage for transmission.
ETX	End of Text	The ETX character is sent at the end of the last block of data in the message text. ETX causes line turnaround to be executed, and a message rejection or acceptance to be generated. If the message is rejected, retransmission of the last block of data occurs. If the message is accepted, an End of Transmission character is transmitted, and the communications line is relinquished. The TermiNet 9600 System then returns to a receive mode.
ETB	End of Transmission Block	The ETB character is sent at the end of a text block within the message text. The ETB causes line turnaround and message acceptance or rejection status to be generated.
ITB (US)	Intermediate Block Check	The ITB character causes the receiver to recognize the next 1 or 2 characters as check characters for the preceding data block. A line turnaround is not caused by the ITB.
EOT	End of Transmission	The EOT character is sent to conclude a transmission.
WACK	Wait before transmit positive acknowledgement (ACK)	The WACK character is a message acceptance response along with a request that no more data be sent. Enquiries are then sent until the response is ACK, EOT, RVI, or NAK. WACK is only generated by the CPU and never by the TermiNet 9600 System.
RVI	Reverse Interrupt	The RVI character is sent by the computer to indicate an acceptance of the received data. It is used to inform the data transmitter to stand by to receive a high priority message. The Controller responds with an EOT, and switches to the receive mode. RVI is sent by the CPU only and never by the TermiNet 9600 System.
ENQ	Enquiry	The ENQ character is sent as a bid for the line in a point-to-point or multipoint data connection. It is also used to indicate an I/O error while transmitting. ENQ can be used to request a repeat of a message response.
ACK 0 ACK 1	Affirmative Acknowledgement	The ACK 0 and ACK 1 characters are sent by the data receiving station to indicate an acceptance of the previous received data block. ACK is also used as a positive response to a poll and select sequence or a line bid.

TABLE 1
BISYNC CONTROL CHARACTERS (Continued)

CHARACTER MNEMONIC	CHARACTER MEANING	CONTROL FUNCTION
SYN	Synchronism	The SYN character is used to synchronize the data receiver and data transmitter. The TermiNet 9600 System requires 2 SYN characters to obtain synchronization, and sends 3 SYN characters at the beginning of each transmitted message.
NAK	Negative Acknowledgement	The NAK character is sent by the data receiver in reply to the last block of data received as a message rejection. NAK is also sent as a reply when the data receiver is not ready to receive.
DLE	Data Link Escape	The DLE character alters the meaning of the subsequent character. It is used to generate certain reply sequences. In the transparent mode DLE is used in combination with certain control characters to highlight the character as control and not data.
PAD	None	The PAD character is added after a transmission to ensure the last character is properly sent. The PAD character is an FF or binary 11111111 character.

Terminet BISYNC PROCEDURE

RECORD CONTROL

The Bisync procedure as incorporated by Controller through the control program utilizes the ACK 0/1 message acknowledgement. This allows the identification of transmitted and received data blocks over the synchronous data lines. The response to an initial enquiry must be an ACK 0 sequence. Following this, the data block transferred is odd. This means the positive acknowledgement response must be ACK 1. The next transferred data block is even requiring an ACK 0 response. The remaining transferred data blocks alternate odd, even, odd, even, etc.

Should a transferred data block be rejected with a NAK sequence, the retransmitted data block will retain the odd or even identity it had during initial transmission.

COMMUNICATION FORMAT

When transmitting data over the synchronous line, the Controller always sends three SYN codes prior to sending the message. It also needs to receive two SYN characters as part of any response sequences.

The number of block check characters sent is dependent upon the number of bits required for the block check. If the block check is sixteen bits, then two block check (BCC) characters are sent. If the block check character is 8 bits, then one BCC character is sent. Sixteen bit block checking is employed when the code set used is EBCDIC. Eight bit block checking is employed when the code set used is ASCII.

Table 2 illustrates a typical data transfer from a TerminiNet 9600 2780 emulation system to a central processing unit (cpu). The exchange illustrated in Table 2 assumes a data path has been established between the terminal and the cpu. The establishment of this data path is discussed in the Terminal Operation portion of this publication.

NOTE

Only one SYN character is shown in the Table for simplicity. Each SYN character shown actually represents three SYN characters transmitted or at least two received. Also, only one BCC is shown when actually two may be transmitted or received.

TABLE 2
TYPICAL TermiNet BISYNC TRANSMIT DATA TRANSFER

TERMINAL TRANSMITTED INFORMATION						CPU RESPONSE			DISCUSSION	
S Y N	E N Q	P A D								The transmit terminal establishes initial contact with an enquiry sequence.
						S Y N	A C K	O P A D		The cpu responds to the enquiry with a positive acknowledgement.
S Y N	S T X	T E X T	I T B	B C C						The transmit terminal sends a STX control character and the first segment of the data block followed by the ITB control character and the block check character or characters. Line turnaround does not occur.
	S T X	T E X T	B C C	P A D						The transmit sends another STX control character and the second segment of the data block followed by the ETB control character and the block check character or characters.
						S Y N	A C K	1 P A D		Line turnaround occurs and the cpu responds with a positive acknowledgement.
S Y N	S T X	T E X T	B C C	P A D						The transmit terminal sends the second data block preceded with an STX, and followed by an ETB plus a check character.
						S Y N	N A K	P A D		This time the cpu rejects the data transmitted to it by responding with a NAK character.
S Y N	S T X	T E X T	B C C	P A D						The transmit terminal repeats the previously transmitted data block. If the data block had been broken with an ITB, the entire block would be retransmitted.
						S Y N	A C K	O P A D		The cpu acknowledges the retransmission positively.
S Y N	S T X	T E X T	B C C	P A D						The transmit terminal sends the last data block and terminates it with an ETX control character.
						S Y N	A C K	1 P A D		The cpu responds with a positive acknowledgement.
S Y N	E O T	P A D								The transmit terminal sends an EOT control character and returns to the receive mode.

In a data exchange such as that illustrated in Table 2 the cpu could respond to a transmission with a WACK character. If the terminal receives a WACK response, it will send an enquiry sequence. (SYN, SYN, SYN, ENQ, PAD). It will continue to send this sequence until the cpu responds with ACK, NAK or RVI.

The positive response to the enquiry sequence is ACK, plus the proper record control (1 or 0) for the previous data block transmitted. The negative response is NAK. This response necessitates a retransmission of the previous data block. An RVI response is treated as a positive acknowledgement by the terminal. Data transmission of any remaining buffer contents will be completed. When this data is acknowledged by either an ACK or an RVI the terminal will send an EOT and return to the receive mode.

TRANSPARENCY

Transparency is an optional feature of the line discipline. It will allow all possible combinations

of an eight bit character to be transmitted or received (i.e., transmission and reception of 8-bit binary data). All information transferred in the transparency mode is treated as data unless the information is preceded with a Data Link Escape (DLE) character. If a DLE character is part of the message information, it must be preceded by another DLE character. The terminal automatically adds the second DLE in the data stream on transmit and strips it out at receive.

The transparency mode is initiated in transmitted text by sending a DLE STX sequence. The transparency mode is terminated at the end of a data segment by a DLE ITB sequence, or at the end of a data block by a DLE ETB or DLE ETX sequence. When the transparency mode is entered following an intermediate data block check character, the DLE STX sequence must be preceded by two SYN characters.

EQUIPMENT CONFIGURATION

The TermiNet 9600 2780 emulation system can be configured in several different ways. The chart shown below (Table 3) illustrates these configurations.

TABLE 3
TermiNet 9600 REMOTE PROCESSING SYSTEM 2780 EMULATION CONFIGURATIONS

TERMINAL TYPE	EQUIPMENT REQUIRED	TYPE OF PROGRAM STORAGE EMPLOYED
Receive Only Terminal	(1) TermiNet 340 Line Printer (2) TermiNet 9600 Communications Controller	EPROM
Send/Receive Terminal	(1) TermiNet 340 Line Printer (2) TermiNet 9600 Communications Controller (3) Card Reader (Peripheral Dynamic Model 3055H or equivalent)	EPROM
Send/Receive Terminal	(1) TermiNet 340 Line Printer (2) TermiNet 9600 Communications Controller (3) TermiNet 30 Printer and MTA	EPROM or RAM
Send/Receive Terminal	(1) TermiNet 340 Line Printer (2) TermiNet 9600 Communications Controller (3) TermiNet 30 Printer and MTA (4) Card Reader (Peripheral Dynamics Model 3055H or equivalent)	EPROM or RAM

The following paragraphs discuss the equipment listed on Table 3 above.

Terminet 340 PRINTER

The system Line Printer is a Pedestal mounted Terminet 340 Line Printer which prints at a maximum of 340 lines of data a minute. It is designed to run in an unattended mode with the operator needing only to tend to the paper supply needs. Its role in the system operation is to act as a high speed print out device. When the central processing unit (cpu) generates information and sends it to the terminal, the information is printed by the Terminet 340 Line Printer.

Terminet 30 PRINTER AND MTA

The system keyboard entry device is a Terminet 30 Printer and its associated Magnetic Tape Accessory (MTA). The Terminet 30 Printer and MTA provides the means for loading the control program into the RAM memory, and sending commands and message data, if required, to the cpu via the Controller. It can also be operated as a low speed interactive terminal if that option is purchased.

The Terminet 30 Printer keyboard provides the means for sending the commands and message data. The MTA provides the means for loading the 2780 emulation control program.

Terminet 9600 COMMUNICATIONS CONTROLLER

The 9600 Controller provides the program storage and control capability required by the terminal. It interconnects the Terminet 340 and 30 Printers and the Card Reader to the cpu through a synchronous data set. Once a program is loaded into the 9600 Controller memory, operation is automatic.

CARD READER, PERIPHERAL DYNAMICS MODELS 3055H (OR EQUIVALENT)

The Card Reader provides the means by which data is loaded via the Controller to the cpu. It is capable of reading 80 column cards at a maximum rate of 500 cards a minute. It can pick cards automatically at this rate or on an individual card basis up to the maximum rate. The Card Reader accepts cards punched in any format and reads the card data column by column.

TERMINAL CONTROL

The TermiNet 9600 Remote Processing System, 2780 emulation, receive only and send/receive terminals utilizes the controls and indicators of the TermiNet 340 Line Printer and, where applicable, the TermiNet 30 Printer. The operation of these pieces of equipment is discussed in equipment operating manuals. Some of the controls and indicators have special function and meaning in the 2780 emulation

discipline. The discussion which follows details these features.

TermiNet 30 PRINTER

Most keyboard controls function as described in the GEK-36115 Operator's Manual. However, when the control mode is entered on send/receive terminals the Table 4 commands can be issued.

TABLE 4

TermiNet 30 PRINTER GENERATED COMMANDS

KEYBOARD SELECTION	COMMAND GENERATED	DESCRIPTION OF COMMAND
I	Initialize Buffers	This key output initializes the Controller storage buffers. Any output in progress will be halted, and any data remaining in the storage buffer will be lost.
C	Communicate/Continue	This command causes the Controller to send ENQ characters over the line at a rate depending on whether the equipment is programmed as a primary or secondary terminal. The TermiNet 9600 2780 emulation system is programmed as a primary terminal. The ENQ characters are sent at 1 second intervals, as soon as the line connection is made. The EPROM program storage versions have strap selectable time intervals.
R	Reset Line	Entry of the R command from the keyboard while in the Command mode causes an EOT character to be placed on the line. This is used to terminate line activity.
K	Keyboard Data Entry	Keying the K command allows input data to be generated from the TermiNet 30 Printer keyboard.
T	Tape Data Entry	Not currently allowed.
ESC	Transmit EOT	The ESC command allows an EOT character to be forced on the line regardless of the operating mode (send or receive).
Ø	Off Line	The off line mode command allows cards to be fed through the card reader and listed on the Printer.
CTL 9	Enter Low Speed Operation	The CTL 9 sequence commands a low speed interactive terminal mode. The TermiNet 30 Printer motor is turned on in this mode. Turning the motor off causes the emulation program to be re-entered.
E	Last Batch	This command is used to inform the Controller that the cards in the Card Reader are the last batch.
X	Transparent	This command is used to inform the Controller that the card data will be transmitted in the Transparent mode.

TermiNet 340 LINE PRINTER

The Line Printer provides the only operator controls on a receive only terminal. The controls and indicators of the TermiNet 340 Line Printer are given below.

MOTOR ON MOTOR OFF

These two buttons control the printer drive motor, and override commands from the Communications Controller. A light between the two buttons is on when the motor is on, and off when it is off. Pressing both buttons at the same time results in a motor off condition.

READY

This indicator is on when the printer is fully powered and ready to print.

ALARM

Indicates low paper, electrical malfunction, or mechanical malfunction. The printer will not print when this light is on.

FORM FEED LINE FEED

The FORM FEED and LINE FEED buttons advance the paper forms to the top of the next form or next line. The motor must be on for the paper to advance.

TEST

The TEST button causes the printer to generate and print a test pattern locally.

INTERRUPT

The TermiNet 340 INTERRUPT button is used to stop the printer. When it is pressed, the printer will finish the current line and any carriage control associated with it, then stop. The READY light will go out. The printer motor will remain on for a short time. To restart printing, press the HERE IS button.

HERE IS

When pressed this button causes the printer motor to turn on, the READY light to come on, and printing to begin. Use of HERE IS is necessary only if INTERRUPT has been pressed previously.

PAPER MOVING CODES

When receiving and printing data using the 2780 emulation format, certain data sequences control paper movement. Table 5 details these paper moving codes.

TABLE 5
PAPER MOVING CODES

EBCDIC CODE	PAPER MOVEMENT AFTER PRINTING
ESC /	1 Line Feed
ESC S	2 Line Feeds
ESC T	3 Line Feeds
ESC U	4 Line Feeds
ESC V	5 Line Feeds
ESC W	6 Line Feeds
ESC X	7 Line Feeds
ESC Y	8 Line Feeds
ESC Z	9 line Feeds
ESC [	10 Line Feeds
ESC \	11 Line Feeds
ESC ~	12 Line Feeds
ESC —	13 Line Feeds
ESC A	Form Feed
ESC B	Vertical Tab
ESC P	No Slew (Next Print Line Will Overprint Current Line)
CR	Carriage Return
LF	Line Feed

Carriage returns and line feeds cause action to occur immediately; however, the other paper moving commands will be held by the Controller and executed at the end of the current print line.

Standard ASCII data transmitted in the transparency mode is formatted using carriage returns and line feeds without ESC control sequences.

TERMINAL OPERATION

PROGRAM LOADING

IMPORTANT NOTE

The following procedure details the program load sequence for the TermiNet 9600 Remote Processing System RAM program storage versions. The EPROM program storage version has a permanent stored program to control it, and does not require program loading at each power up cycle. Therefore, this procedure does not apply to a TermiNet 9600 System EPROM program storage version.

1. Turn on the AC power to the equipment. Be sure the READY light and the POWER light on the TermiNet 30 Printer are on.

2. Insure that the TermiNet 30 Printer motor is off.

3. Press the lock switch on the Magnetic Tape Accessory (MTA), insert the program tape cassette, and press the lock/stop switch on the MTA to the middle (neutral) position.

4. The 2780 emulation program will now automatically be entered into the Controller memory. The READY light and the MTA READ CONTINUOUS light are on during the program load time. The program tape will be automatically rewound after the program load.

5. A good load will be indicated two ways.

- a. The TermiNet 30 Printer bell will sound.
- b. The TermiNet 30 Printer will print the following message:

THE 2 7 8 0 EMULATION IS LOADED
AND READY FOR YOUR COMMAND
DEPRESSING THE INTERRUPT PUTS
THE KEYBOARD INTO THE COMMAND
MODE

6. At this time the TermiNet 340 Line Printer READY light should be on.

NOTE

A quick check to determine if the program is resident in the Controller memory is to press

the TermiNet 340 Printer INTERRUPT control. If the program is running, the READY light will turn off and the Printer bell will sound. The HERE IS control must be pressed after performing this test. This quick check may be done at any time deemed necessary.

7. A bad load will result in the TermiNet 30 Printer printing BAD LOAD. The Line Printer READY light will not turn on. The TermiNet 30 Printer will print BAD LOAD any time the motor is turned on and the program is not resident in the Controller memory.

CAUTION

If the TermiNet 340 power switch is turned off, or the power plug is removed from the electrical outlet, the memory program in the controller is lost. The program will have to be reloaded per the above procedure.

ESTABLISHING A DATA LINK

To establish a data link, the station must provide an alphanumeric sequence which the cpu will recognize. This sequence is sometimes referred to as a user number or a sign on number.

Once a program is resident in the Controller memory, the sign on number may be entered into the Controller data storage buffer on send/receive terminal configurations from the Card Reader via a prepunched card, or from the Printer keyboard. Read only terminal configurations have no provision for manually entering the sign on number. In these units, the number is stored in a special memory location. The remaining buffer space may be filled with data. The sequence for the send/receive terminal is as follows:

1. Printer prints the good load message (RAM versions only).

2. Press INTERRUPT on TermiNet 30 Printer.

3. Type "I" then type "K".

4. Enter sign on number from the keyboard (refer to keyboard data entry discussion below).

or

3a. Type "I".

4a. Read the sign on number card with the Card Reader.

5. The sign on number is automatically stored in the Controller data storage buffer. The remaining buffer space may be filled at this time with data.

6. Dial up the cpu site on the data phone. Two audible tones will be heard in the phone receiver. The first will be high pitched, and the second will be low pitched. When both tones have been heard, press the DATA control on the data phone and hang up the handpiece.

7. The data link is established.

8. Type "C" on the keyboard. The sign on number is sent to the cpu. When it is accepted, the remaining data is sent.

The sequence for the read only terminal is much shorter.

1. Dial up the cpu on the data phone. Listen for the tones, as discussed in step 6 above, and press the DATA control.

2. The data link is established.

3. The sign on number is sent to the cpu from the Controller memory. When it is accepted, the cpu sends data to the terminal.

OPERATION

CARD READER DATA ENTRY

The following discussion details the procedure for entering data from the Card Reader.

1. Establish a good program load, as detailed previously. Press the INTERRUPT control on the Printer keyboard. The Printer will print a "?".

2. Ready the data cards in the Card Reader.

3. If the deck of cards are the last batch to be transmitted, type an "E" on the Printer keyboard.

4. Call the cpu and establish a data link, as detailed previously.

5. When the modem connections have been established, type a "C" on the Printer keyboard.

6. The data cards will now be read by the Card Reader and transmitted by the Controller to the cpu.

KEYBOARD DATA ENTRY

1. Once a program has been loaded press the INTERRUPT control on the Printer keyboard. The Printer will print a "?".

2. Type "I" on the Printer keyboard. The Controller storage buffers will initialize.

3. Type "K" on the Printer keyboard. The Printer bell will sound.

4. Data may now be entered from the keyboard.

a. Each line of data must end with a carriage return and a line feed.

b. Each line of data can contain a maximum of 80 printable characters.

5. Data can be entered from the keyboard until no further data entry is required, or until the keyboard locks prohibiting further data entry.

6. If data entry is finished before the keyboard locks, type CTL D (End of Text). The keyboard now locks.

7. In either case (step 5 or 6), press the INTERRUPT control on the Printer keyboard.

8. Establish a communications data link to the cpu per established procedures. When modem connections have been established, type a "C" on the Printer keyboard.

9. When the Printer bell sounds, further data entry is possible. Terminate finished data entry by typing CTL D.

KEYBOARD ERROR CORRECTION

Typing an "@" key causes the last character in a current line of data to be deleted from the Controller memory. Each subsequent "@" character typed causes an additional character to be deleted from the current line of data. After the erroneous character or characters have been deleted from the Controller memory, the correct data can be entered.

NOTE

The TermiNet 30 Printer print head does not backspace. The print out will show the erroneous data followed by the typed "@" characters and the correct data. Actual error cor-

rection occurs in the Controller, and only the corrected data is sent to the cpu.

LOW SPEED INTERACTIVE TERMINAL MODE

A low speed interactive terminal mode can be entered by typing a CTL 9 on the Printer keyboard. The Printer motor turns on in this mode. Turning the motor off re-enters the equipment into the program controlled mode.

This mode of operation is optional and requires additional circuit boards and a 300 baud modem connection to the Controller. If the option is available, the TermiNet 30 Printer can be operated in the low speed mode per the details provided in the Operator's Manual.

SYSTEM NOTES

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